CHAPTER 8 - DID REPTILES EVOLVE INTO MAMMALS?

This book does not pretend to be an exhaustive treatment of the creation/evolution controversy, but rather a resource to furnish background information for science teachers up through high school. One of the most common questions in this age group is whether humans evolved from some sort of apelike ancestors. In this and following chapters we will look at the fossil evidence to see whether it supports or refutes this idea.

Visual # 8-1 Fossils are assigned ages based on the rocks in which they are found. However, the ages of the rocks were assigned based on the fossils they contain, before the discovery of radioactivity and the development of radiometric dating techniques. Regardless of whether the ages are right or wrong, major types of fossils are associated with specific strata. For instance, we have seen that rocks up through the Devonian Period contain only the types of creatures that would be expected to live in the sea and dinosaur fossils are only found in rocks classified as belonging to the Mesozoic Era. In this and following chapters, we will see that primates, the group that includes humans, are found only in the Cenozoic Era and undisputed humans only in the Quaternary Period.

Visual # 8-2

References to standard geologic time scales will be used throughout this material. Even if the geologic time scale is correct, evolution is nowhere to be seen in the fossil record.

I. SIMILARITIES AND DIFFERENCES BETWEEN LIVING THINGS.

A. SOURCE OF SIMILARITIES AND DIFFERENCES.

Visual # 8-3 Both Initial Complexity and Initial Disorganization examine the same fossil evidence. The difference is not in the evidence, but in how it is interpreted. The two concepts lead to very different explanations for similarities and differences between living and fossilized animals and plants.

1. ***INITIAL COMPLEXITY*** - *Common design.*

Visual # 8-4 Initial Complexity leads us to believe that at the beginning, there was a great deal of diversity built into the DNA of every type of living thing. Thus, we would tend to interpret similarities between forms in different areas or environments as the result of *common design*, and differences as the result of genetic variability. Common design does not require any specific amount of time, but it allows for a relatively short time frame punctuated by catastrophic events.

In this model, suites of fossils are interpreted as representing ecological communities whose members tended to do best in specific environments until they were buried under catastrophic conditions.

2. ***INITIAL DISORGANIZATION*** - *Common ancestry and random mutations.*

Initial Disorganization leads us to interpret similarities as the result of *common ancestry* and differences as the result of random evolution. Common ancestry automatically requires hundreds of millions of years and therefore depends upon uniformitarianism.

The suites of fossils represent time periods during which the animals and plants happened to evolve the same amount in different locations around the world.

B. CLASSIFICATION SYSTEMS.

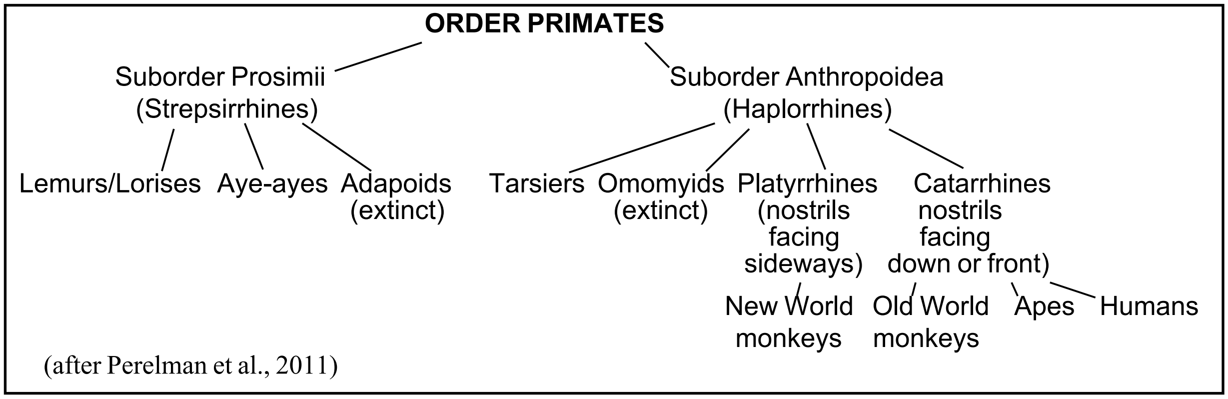
1. ***LINNAEAN SYSTEM.***

Visual # 8-5 In the Linnaean system of classification, animals and plants are grouped according to similarities without any attempt to determine why the similarities exist. For example, humans are classified into Kingdom Animalia, Phylum Chordata, Subphylum Vertebrata, Class Mammalia, Order Primates, Family Hominidae, Genus Homo, and species sapiens. Common prefixes and suffixes are: “anthropo” indicates human-like, “Homo” indicates something to do with humans, “sim” indicates something to do with monkeys, and

"-pithecus" indicates "ape." (Monkeys have tails but apes do not.)

In the Linnaean system, Primates are commonly broken down into subgroups as follows:

Visual
8-6



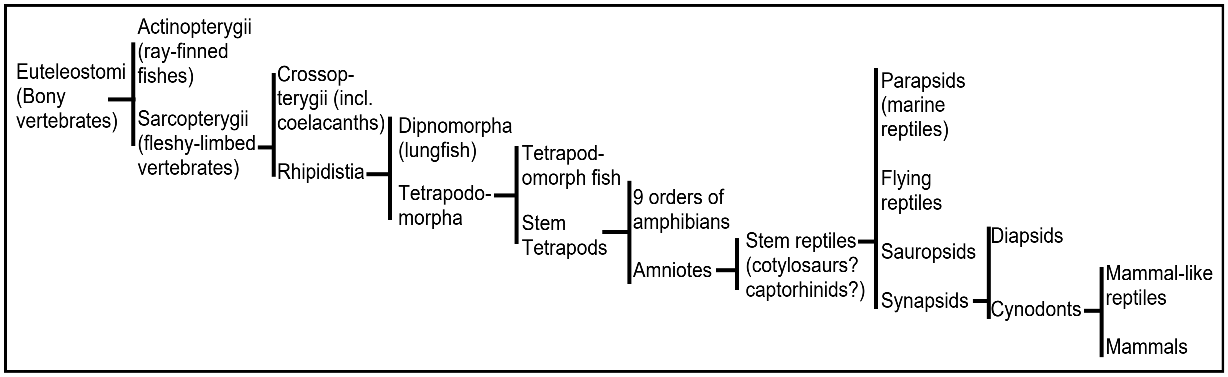
(after Perelman et al., 2011)

2. CLADISTICS.

Cladistics assumes that the diversity of living things is due to evolution. Thus, everything is related to everything else. The connections of each type to its ancestors and relatives are often shown in cladograms, used to illustrate evolutionary relationships in science textbooks. The fact that ancestors or transitions may not be known is no hindrance in producing cladograms. Missing forms are left blank or represented by terms such as "stem."

The main focus of this chapter will be the ancestry of mammals, which include primates and humans. Mammals are supposed to have evolved from reptiles, which are supposed to have evolved from amphibians, which are supposed to have evolved from fish, etc. The evolution of fish into amphibians into stem reptiles into advanced reptiles and mammals could be represented in a simple cladogram such as this:

Visual
8-7



C. WHY WOULD ANYTHING EVOLVE INTO ANYTHING ELSE?

The physical structures (bones, hearts, brains, tails, etc.) of every living creature including primates are present because their DNA contains the instructions on how to assemble them and put them in their proper places. It would have taken thousands or millions of beneficial mutations for some early primate to evolve into all the different types of monkeys, apes, and humans.

1. LAMARCKIANISM.

Visual
8-8

Many still mistakenly believe that animals acquire new features as they need them and lose old ones when they are no longer needed. As discussed in earlier chapters, this belief has been thoroughly falsified. The physical features (the phenome) of each type of animal or plant are determined by DNA (the genome), not use and disuse of body parts. Though individuals may develop stronger or weaker muscles through use and disuse, the changes are not passed on to the next generation. Animals and plants do not get what they need; they get what their DNA gives them.

2. *DNA ERROR CHECKING AND CORRECTING MECHANISMS.*

In Section Chapter Four we saw (Sarfati, 2018; Brutlag & Kornberg, 1972; Radman & Wagner, 1988) that every type of organism ever studied has elaborate mechanisms to prevent and correct errors during DNA reproduction.

Visual # 8-9

- First, a series of enzymes known as ligases, helicases, and topoisomerases separate, unwind, and prevent the two halves of the DNA strand from becoming tangled.

Visual # 8-10

- Next, DNA polymerases assemble the correctly matching nucleotides Adenine and Thymine and Cytosine and Guanine into matching halves of a new DNA strand. Because of the matching numbers of hydrogen bonds between the nucleotides, only about 1 in 100,000 matching attempts results in a copying mistake

Visual # 8-11

- Then, enzymes known as proofreading exonucleases move along the newly formed DNA strand to detect and correct errors. This brings the number of mistakes down to about 1 in 10,000,000.

Visual # 8-12

- Then, some of the polymerases recheck the new DNA strand. If they find any errors, they snip them out and repair the defective sections. This reduces the rate of errors to about 1 in 10 billion base pairs.

a. Initial Complexity.

Initial complexity implies that some sort of intelligent being is responsible for the existence of this process. It was probably present from the beginning of life.

b. Initial Disorganization.

Initial Disorganization (simple to complex) requires us to believe either that:

Visual # 8-13

i. DNA did not evolve for millions or billions of years after life began. The first living things used some far simpler information storage system, unknown to us. They did not have any error-correcting mechanisms at all. The elaborate error-correcting mechanisms had to be added to DNA later, one mutation at a time. This implies that the intricate system of enzymes that prevent errors itself had to be the result of thousands of perfectly coordinated errors. That is, ERRORS produced the ERROR PREVENTION mechanism. OR,

ii. Some intelligent being brought living things into existence in a disorganized condition, added the error correcting mechanism much later, then overrode it millions of times in order to have evolution.

II. ORIGIN OF MAMMALS.

Since we humans belong to Order Primates which in turn belongs to Class Mammalia, the origin of mammals is relevant to the origin of primates.

A. INITIAL COMPLEXITY.

Visual # 8-14

Initial Complexity says that mammals did not evolve from anything else but were brought into existence as fully formed mammals.

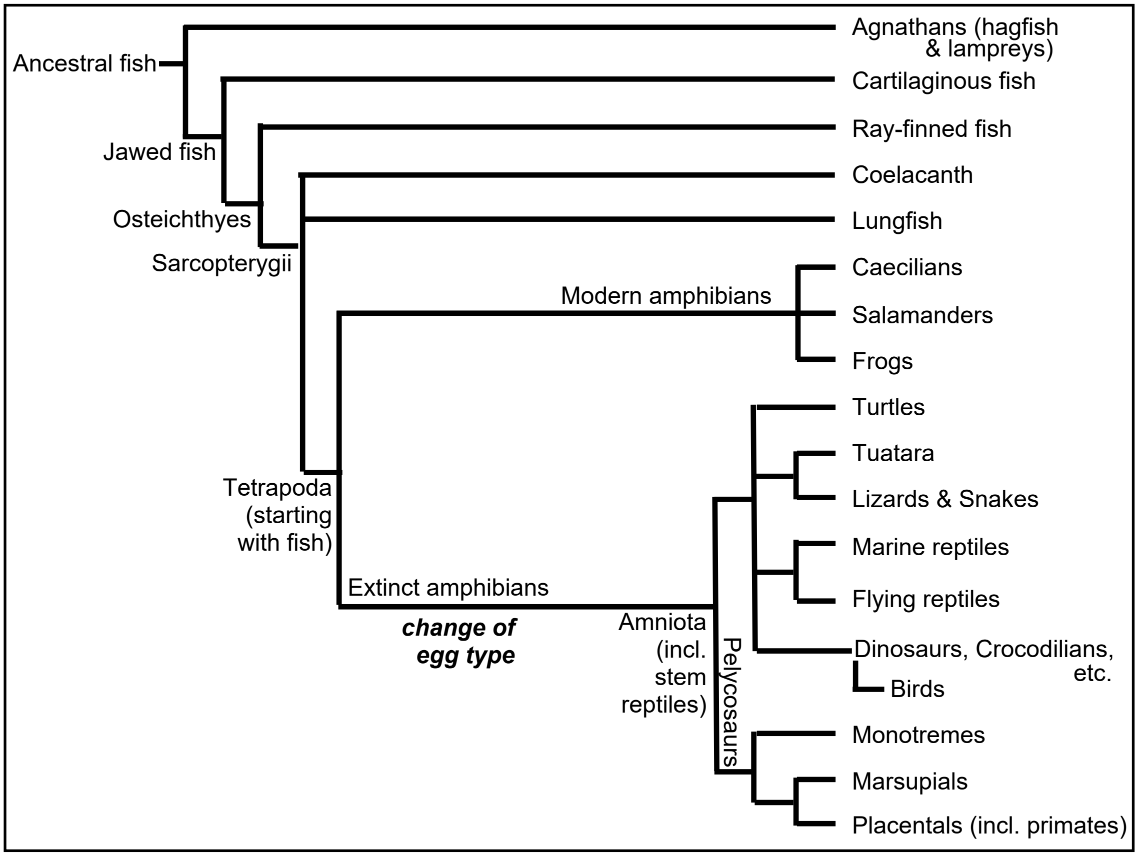
B. INITIAL DISORGANIZATION.

Initial Disorganization says that millions or billions of mutations in DNA brought about all the types of living and extinct creatures from an original single celled ancestor.

- Life began as a chemical accident about 3.5 billion years ago.
- During three billion or so years before the Cambrian, the descendants of the unidentified first living cells diverged into animals, plants, fungi, etc.
- Some of the one-celled animals turned into multi-celled forms.

- These evolved into some type of soft-bodied invertebrates.
- Some of these became vertebrates by developing a structure similar to a notochord, which evolved into a backbone.
- Then, some of the vertebrates became fish.
- One group of these left the water and became stem amphibians.
- These diversified into nine known orders of amphibians and also into stem reptiles.
- These continued to evolve into multiple types of reptiles.
- One of the reptile types evolved into the lowest mammals (marsupials and monotremes) as well as the "higher" placental mammals.
- One of the placental types evolved into primates.

Visual # 8-15



C. RELEVANT STRATA ON THE GEOLOGIC COLUMN.

Visual # 8-16

Initial Disorganization takes for granted that the strata of the geologic column represent time periods known as Eras, Periods, and Epochs as described below. The development of mammals could be represented by a cladogram such as the one above showing some unknown fish evolving into an unknown amphibian evolving into an unknown "stem reptile" which then evolved into an unknown mammal-like reptile that evolved into an unknown type of mammal.

Initial Complexity interprets the named strata as representing **ecological communities** that were subjected to catastrophic conditions leading to mass burial, either at their original location or after being transported elsewhere. Thus, rather than there being five epochs within the Tertiary Period as described below, the named divisions represent five distinct ecological communities that lived at the same time but probably in different places where the environment was different.

Visual # 8-17

1. ***ARCHAEOZOIC ERA.***

   At the lowest level of the geologic column is the Archaeozoic (Pre-Cambrian) Era. It contains very few fossils, all of which are ocean dwelling types. Life is supposed to have begun some time around 3.5 billion years ago during the Archaeozoic.

2. ***PALEOZOIC ERA.***

   The next higher major division is the Paleozoic Era. Depending whether the Carboniferous is taken as one unit or split into two, the Paleozoic is subdivided into six or seven Periods.

   The four lowest layers of the Paleozoic are the Cambrian, Ordovician, Silurian, and Devonian. These contain communities of fossils we would expect to find from the ocean bottom to progressively shallower depths. The Devonian is known for shallow-water fish of the kind we would expect to find near sea level. It also contains the amphibians found at the lowest geologic level and thus considered the oldest.

   - The Carboniferous (Mississippian and Pennsylvanian) contains a great many types of amphibians that would be expected to live in swampy and marshy environments at or a bit above sea level.
   - It also contains a vast quantity of plants, many of which have been preserved in enormous coal deposits.
   - The Permian also contains many reptiles that had characteristics considered mammal-like.

   If suites of fossil animals and plants represent ecological communities, the presence of so many reptiles in the Permian would imply that the Permian environment was considerably drier than the Carboniferous, possibly because it was farther inland.

3. ***MESOZOIC ERA.***

   The Mesozoic is known as the “age of reptiles” because of the predominance of that type of animals in Mesozoic strata.

   In addition to reptiles, a few types of mammal fossils have been found. The fossil claimed to be the very first mammal is known as *Morganucodon*, dated to the Triassic/Jurassic boundary, ca. 205 MA. (Some researchers consider *Eozostrodon*, described on the basis of several teeth, to be the same animal.)

   Mesozoic mammals include marsupials, monotremes, and rodent-like animals believed to have been insectivores. The rodent types appear suddenly in the upper Triassic without known ancestors; the first tentative monotreme in the Cretaceous of Australia (Archer et al., 1985); and the first marsupials in the Cretaceous of Utah (Cifelli, 2009). No specific type of mammal-like reptile has been proposed as a possible ancestor to any of them. Some of the basic types continue to the present, while others are believed to be extinct.

4. ***CENOZOIC ERA (the “Age of Mammals”).***

   Above the Mesozoic is the Cenozoic Era, known as the “Age of Mammals.” It includes both the Tertiary and Quaternary Periods. The Tertiary, in turn, is subdivided into the Paleogene and Neogene sub periods.

   a. Paleogene Sub period.

   Primates include monkeys, apes, humans, lemurs, and similar types. The *Paleogene* (lower Tertiary) is the lowest layer that contains *disputed* possible primates, in rocks dated to the Paleocene Epoch. The lowest layer that contains *undisputed* primates is the Eocene. Various types of primates are also found in the Oligocene.

b. Neogene Sub period.

Neogene (upper Tertiary): Primates of different types are also found in the Miocene and Pliocene Epochs.

c. Quaternary Period

Quaternary: The Pleistocene Epoch is the lowest layer that contains fossils of undisputed humans, as well as all the modern primates and other mammals. The Holocene (Recent) is above it.

D. GENERAL STEPS NEEDED FOR AMPHIBIAN-TO-REPTILE-TO-MAMMAL EVOLUTION.

The physical structures of every type of animal and plant (the phenotype) are determined by the contents of the DNA (the genotype.) It would take many mutations for ancient amphibians to evolve the features that would identify them as reptiles. Further evolution into different types of reptiles and then into mammals would require a great many more mutations in the DNA of each evolving line.

1. RECAP OF DIFFERENCES.

a. Amniote Eggs.

Visual # 8-18

One of the most important changes would be that some ancient line of amphibians would have to undergo a chain of mutations to develop amniotic eggs. This would have to happen in a single generation to both a male and female living at the same time and place, or else fertilization and therefore reproduction would be impossible.

b. Method of fertilization.

At the same time as the new egg type developed, the mutations would also have to produce the instinct in both the male and female to perform internal rather than external fertilization.

c. Elimination of metamorphosis.

The mutations would also have to change the newly hatched young so they would would no longer go through metamorphosis, but would emerge as fully formed miniature versions of adults.

d. Miscellaneous features.

The rest of the reptilian features could develop stepwise, but the process would require a lengthy series of beneficial mutations. The developing reptiles would need to acquire at least: dry skin protected by scales, lung breathing, eyes adapted for land vision, eyelids and tear glands, progressively stronger backbones, and thoracic and pelvic girdles so as to be able to support the animal's weight on land.

e. Genetic Potential.

The newly evolved "stem reptiles" would need to have the potential in their DNA to produce many lines of descendants.

2. SKULL STRUCTURE IN REPTILES.

Visual # 8-19

One of the main criteria used to classify amniote fossils (reptiles, mammals, birds) is the number of openings (*temporal fenestrae*) in the skull behind the eyes.

Visual # 8-20

a. *Anapsids* (*e.g.*, turtles and extinct captorhinids) have no openings in their skulls behind the eyes. (Amphibians do not have openings either, but are omitted from this group since they are not amniotes.)

Besides producing skulls with no temporal fenestrae, the DNA of the anapsid stem reptiles also had to diversify to produce animals with shells and all the other features of turtles and tortoises.

b. Synapsids.

The early anapsid DNA would have had to mutate somehow so as to change into a form producing synapsids, which had skulls with a single opening behind the eye on each side. Somewhere along the way they would have had to evolve into "mammal-like" reptiles (pelycosaurs) with legs splayed toward the sides, and separately into therapsids, which had legs directly underneath the body. They are also alleged to be the ancestors of mammals.

One group of synapsids, the mosasaurs, seems to have been aquatic. Others are alleged to have developed into mammals as discussed below.

c. Diapsids.

Visual
8-21

Separate from the line evolving toward synapsids, the original anapsid DNA would have to undergo a different set of mutations leading to diapsids. These animals had a second opening behind the eye on each side of the skull, furnishing an attachment point for the jaw muscles.

In addition to developing the second opening, the diapsids would have had to branch out into the two orders of dinosaurs Ornithischia and Saurischia, as well as poisonous and nonpoisonous snakes, Class Aves (birds), and flying reptiles of Order Pterosauria. Such diversification would have required the loss of legs in snakes; the development of feathers; different breathing mechanisms; warm-bloodedness; a four-chambered heart in crocodilians only; and many other changes in other types of diapsids. All these changes are claimed to have evolved by random mutations.

Since the mammal-like features of the Paleozoic and Mesozoic synapsids are considered to be more advanced than those of the dinosaurs found higher in the geologic column, the dinosaurs are considered to be a side branch of reptiles rather than descendants of the synapsids found in lower layers.

d. Euryapsids.

Visual
8-22

While the DNA of the ancestral reptiles was evolving to produce the synapsids and diapsids, some of them would have had had to undergo a separate set of mutations to produce the Euryapsids, marine reptiles of Orders Ichthyosauria and Sauropterygia (plesiosaurs). Like the synapsids, euryapsids had a single opening on each side of the skull behind the eyes. However, their fenestrae were at the top of the skull, in contrast to the low openings in the synapsids.

Rather than being directly descended from those of anapsids, euryapsids' skulls are believed to have come about by degeneration from those of diapsids (De Iuliis & Pulerà, 2011).

- First, the DNA of some unknown type of anapsid would have to evolve to produce the single fenestral opening in synapsids.
- The DNA of some synapsid would have to evolve to produce the two openings of diapsids.
- The DNA of some diapsid would have to evolve so that one of the openings closed up and produced the single high opening characteristic of euryapsids.

3. *PROBLEMS WITH TIMING.*

If amphibians are the ancestors of all the amniotes (reptiles, mammals, and birds), at least one of them would have had to evolve into "stem reptiles" which in turn evolved into advanced reptiles, mammals, and birds. Since the stem reptiles would have been some sort of anapsids, we would expect that their fossils would have long predated the synapsids, diapsids, and euryapsids.

a. *Transition from amphibian to reptiles.*

Visual # 8-23

One of the problems that arises in searching for the transition from amphibian to reptile is the strata in which they are found. The 60 cm long amphibian *Seymouria* (which would be considered an anapsid if it were a reptile) is dated about 280-270 MA. The much larger 2 m long anapsid reptile *Diadectes*, supposed to be evolved *from* it, is dated about 10 million years *earlier*, at 290 MA.

b. *Earliest Stem reptiles.*

The stem reptiles would presumably have included the "most primitive" anapsids such as the 20-30 cm long *Hylonomus*. However, this animal is dated in the Late Carboniferous, ca 315-312 MA (Romer, 1966, 103-104). This is over 20 million years ***before*** *Seymouria*, the amphibian supposed to be the ancestor of reptiles. Likewise, the anapsid *Paleothyris*, ca 312-304 MA, is at least 15 million years too early to be descended from *Seymouria*.

Both *Hylonomus* and *Paleothyris* appear suddenly in the fossil record with no known evolutionary connections to amphibian ancestors. Since no specific ancestors have been proposed, there is no way to know what type of skulls earlier creatures might have had.

i. Proposed ancestor of stem reptiles.

Visual # 8-24

The only presently known candidate that might fit as an ancestor is the lizard-like lepospondyl amphibian *Westlothiana*. This animal is dated ca 338 MA, about 26 million years before *Hylonomus*. However, there are a number of reasons why it has not been proposed as an ancestor for either of these reptiles. Besides the fact that its DNA would have had to mutate to produce amniotic rather than gelatinous eggs, it would also have had to shift from producing lepospondylous vertebrae to the rhachitomous type found in reptiles.

Eldeceeon rolfei, *Silvanerpeton miripedes*, and *Termonerpeton makrydactylus* are Early Carboniferous forms that have also been proposed as possible stem amniotes. Though *Silvanerpeton* is known from a number of fossil fragments, *Eldeceeon* is known from only a few fossil specimens (Ruta et al., 2020), and *Termonerpeton* from a single foot designated NMS G. 1992.22.1 (Clack et al., 2022). Since mature amphibians are difficult to tell from reptiles, it is impossible to tell from the bones if they were amniotes or amphibians. We cannot be certain without finding some of their eggs.

ii. Unknown connection to later reptiles.

Visual # 8-25

No specific candidates have been proposed to connect *Hylonomus* or *Paleothyris* to later reptiles. Whether they or some other anapsid were the stem reptiles from which others evolved, the DNA would have had to undergo vast numbers of mutations to diversify into all the other groups.

iii. Synapsids.

Since synapsids are supposed to have been more advanced than anapsids, they would be expected to appear later in the fossil record. However, the possible synapsid *Asaphestera* (disputed because of the fragmentation of the fossil) is commonly dated about 318-314 MA, around the same time as the anapsid *Hylonomus*. An undisputed synapsid, *Archaeothyris,* is dated to the late Pennsylvanian, ca. 306 MA, a bit later than *Asaphestera*, but still long before *Seymouria* and *Diadectes*.

iv. Diapsids.

Diapsids are supposed to have evolved either from synapsids or else in a parallel line with them. The first known diapsid, the 40 cm long *Petrolacosaurus*, is dated to the middle Pennsylvanian at about 300 MA (Reisz, 1977, 1091-3). This is also tens of millions of years before the transition from amphibian to reptile (*Seymouria* to *Diadectes*) is supposed to have take n place.

c. Contrasting explanations.

There are several possible explanations for the problems with the timing of the fossils.

i. Young-earth creation.

Visual # 8-26

Young-earth creation would lead us to believe that the strata represent ecological communities. The fossils are out of the expected sequence because the dating system is wrong. The transitions never existed.

ii. Old-earth creation.

Many old-earth creationists accept the time scale, but agree that the transitional forms are not found because they never existed.

iii. Evolution.

Evolutionists believe the transitions may have been in existence for millions of years but have not been found because they were not fossilized.

None of these beliefs can be tested. Each is purely a matter of faith.

4. MARINE REPTILES.

Visual # 8-27

Besides the change in basic skull structure from earlier types to the synapsid arrangement of mosasaurs and the euryapsid configuration of ichthyosaurs and sauropterygians (plesiosaurs), the marine reptiles would have had to take many steps backward so as to return to the water like their amphibian ancestors. The ichthyosaurs had to completely lose their legs, the plesiosaurs had to develop flippers in place of the legs, and the mosasaurs had to develop webbed feet. Meanwhile, they would have needed to be able to move around and catch prey so they could survive through all the transitional steps.

5. "MAMMAL-LIKE" REPTILES.

Visual # 8-28

The term "mammal-like" reptile is seldom used any more. It indicates types that had some features more like mammals than those of other reptiles, e.g., tooth arrangement, lower jaw structure, and number of openings in the skull. The alleged ancestors are classified as synapsids along with mammals because of the single opening on each side of their skulls. They are often called non-mammalian synapsids.

a. Pelycosaurs.

The pelycosaurs are non-mammalian synapsids found in the middle Pennsylvanian to middle Permian. The lowest pelycosaur in the fossil record, *Ophiacodon*, is commonly dated about 306-280 MA. The one found at the highest level, an unnamed specimen known as SAM-PK-K10407, is dated ca 260 MA (Modesto et al., 2011, 1027-1029).

Pelycosaurs appear suddenly in the Permian with no known ancestry. They are not considered to be ancestors of mammals, but rather, a side branch of reptiles (a *sister taxon*) that became extinct at the end of the Permian (Jehle, 2006). They also disappear with no known descendants.

b. Therapsids.

Most cladists believe all the synapsids (mammals, pelycosaurs, and an overlapping "sister group" of the pelycosaurs called *therapsids*) evolved from a common ancestor

Visual # 8-29

despite their many differences.

Therapsids are known for having legs placed under the body rather than sprawled out to the side as in non-therapsids.

Many dinosaurs had a similar leg arrangement, but they had diapsid skulls.

The most complete record of therapsids is from the Karoo Supergroup of South Africa, dated from the middle Permian to early Jurassic (Abdala et al., 2019) and estimated to contain billions of vertebrate fossils. The oldest therapsid is thought to be *Tetraceratops*, identified on the basis of a single crushed skull (Spindler, 2020), commonly dated about 280 MA. The last non-mammalian therapsids are dated to around the beginning of the Cretaceous. Though they are alleged to be the ancestors of more advanced reptiles and of mammals, no specific transitional forms have been proposed to connect them to those groups.

c. Non-mammalian cynodonts.

Visual # 8-30

Cladists place mammals and some types of therapsid reptiles in a smaller group known as *cynodonts*. These have "dog-like" teeth, contrasted to non-cynodonts such as the gorgonian *Lycaenops* that had teeth better suited to shearing.

Many cynodonts are found throughout the Permian, especially in the Karoo of South Africa. Those considered to be the oldest are non-mammalian types (usually called reptiles in the past) such as *Charassognathus* and *Procynosuchus*, found in Paleozoic strata dated to the later Permian (Abdala et al., 2019). The uppermost known non-mammalian cynodonts, *Scalenodontoides* and *Elliotherium*, are found in Mesozoic strata of the upper Triassic.

Visual # 8-31

Visual # 8-32

The meaning of the suites of fossils used to identify rock strata is a matter of interpretation. Initial Disorganization automatically assumes that these characteristic assemblages developed over millions of years, whereas Initial Complexity allows for the possibility that they represent ecological communities.

6. TRUE MAMMALS.

There are many obvious major differences between reptiles and mammals.

Visual # 8-33

- Mammals display maternal behavior (including mammary glands by which they produce milk and nurse their young), warm bloodedness, and hair. However, since these all have to do with soft parts, we cannot be sure whether extinct animals nursed or were warm blooded. (By contrast, jaw and middle ear structure have to do with hard parts. We will consider them shortly.) Babies are significantly different in shape from adults.
- All known mammals have a diaphragm which pulls downward to create negative pressure in the lungs so as to draw in air. The only known reptiles that have a structure anything like the diaphragm are crocodilians, which, unlike mammals, have to move their pelvises to draw in air. Since the diaphragm is soft and unlikely to fossilize, we cannot tell for sure if any "mammal-like" reptiles had it.

According to Initial Disorganization, all these features would have had to develop because of mutations in the DNA of their evolving ancestors.

Depending on who does the classifying, mammals are divided into about 32 extinct and living orders. The two orders considered most primitive are monotremes and marsupials, which differ radically from the rest of the mammals (the placentals) in their method of embryonic development.

The only known living monotremes are the platypus and the echidna (spiny anteater).

Living marsupials include opossums, kangaroos, koalas, and many others.

a. ***Monotremes.***

Visual # 8-34

Monotremes are unique among mammals in laying eggs, but the eggs are leathery rather than hard like those of birds. Most of their embryonic development occurs between the time they hatch (about 10 days) and leave the nest several months later. Since monotremes do not have nipples, the babies nurse by licking mammary patches on the mother's abdomen (Enjapoori et al., 2014). Monotremes have no stomach to store food but instead digest nutrients directly from their intestines (Choi, 2013).

Mammals are considered cynodonts because of their tooth arrangement. Echidnas present a problem in classification because they never have teeth. Nevertheless, since they belong to Class Mammalia, they are still considered cynodonts. (The other type of monotremes, the platypuses, only have teeth during infancy. They lose them before adulthood.)

Living monotremes consist of four species of echidnas and one species of platypus.

i. *Echidnas* lay a grape size egg which hatches in about 10 days. The babies are too immature to survive on their own and must remain in the nest, where they nurse until they are about 7 months old. Some echidnas grow up to 30 inches (about 75 cm) long.

ii. *Platypus:* The platypus has webbed forefeet, clawed hind feet, a beaver-like tail, and a bill that looks like duck's except that it is leathery and not hard. The bill has electric sensors that allow the platypus to detect small prey in the mud. Males have spurs on hind feet attached to poison glands.

Newly hatched platypuses are only about one inch long when they emerge from their eggs about 10 days after laying. They continue their embryonic development for up to four months while they remain in the nest and nurse. The maximum size of the adults can be as much as 2 ft long, though one fossil species was up to 3 feet long.

b. ***Marsupials.***

Visual # 8-35

Marsupials (e.g., opossums, kangaroos, koalas) bear immature young that immediately crawl inside the mother's pouch and fasten themselves to teats. They nurse inside the pouch until they are fully ready to emerge.

Many of the 250 or so species of marsupials have close placental equivalents. Living forms include sugar gliders (marsupial flying squirrels), marsupial moles, rats, mice, anteaters, cats, groundhogs (wombats), and wolverines (Tasmanian devils). There were also several extinct marsupials similar to placentals: marsupial wolves (*Thylacinus*), rhinoceros (*Nototherium*), and panthers (*Thylacoleo*).

Since marsupials are not considered close relatives of the placental mammals, there are two possible explanations for the similarities:

i. *Simple to Complex Model.*

The ancient marsupials and placentals had to come from a common ancestor. They evolved two radically different modes of reproduction, then experienced "convergent evolution" in which their DNA independently evolved so as to produce dozens of types of similar descendants, or

ii. *Complex to Simple Model.*

Both the marsupials and the placentals began with information in their DNA needed to produce similar results.

Neither possibility can be tested.

c. Placentals (Eutherians).

Visual # 8-36

All the other mammals are called placentals because the young are nourished through a well developed placenta until birth. (Though marsupials rely on a placenta for a short time, they are not classified in this group because the gestation period between conception and birth is so brief.)

Visual # 8-37

Living placentals include dozens of diverse forms such as rodents, bats, shrews and moles (which are not rodents), hedgehogs (also not rodents), lagomorphs (rabbits and hares, also not rodents), primates (humans, monkeys, apes), whales and dolphins, elephants, odd-toed hoofed animals, even-toed hoofed animals, manatees, carnivores, aardvarks, armadillos, pangolins, and many others. In order for mammals to evolve in the first place, there would have to be a great many beneficial mutations in the DNA of some sort of non-mammalian cynodont to produce the first mammals. There would later have to be thousands or millions more beneficial mutations to produce all the diverse orders of living and extinct mammals. All this would have to happen in spite of the error-correcting mechanisms built into the cell's reproductive system.

E. HYPOTHETICAL STEPS NEEDED FOR TRANSITION FROM REPTILE TO MAMMAL.

Though evolutionists try to accentuate the similarities between reptiles ("non-mammalian cynodonts") and mammals while minimizing the differences, a great many structures would have to transform or appear for the very first time in evolving mammals.

1. MAJOR ANATOMICAL DIFFERENCES.

Besides the changes that would have to occur in DNA, many visible structures would have to change due to random mutations. For instance, the definitive reptile jaw/middle ear would have to go through stages including a Transitional Mammalian Middle Ear (TMME) before finally arriving at the Definitive Mammalian Middle Ear (DMME).

a. Jaws and Skulls.

i. Reptiles

Visual # 8-38

Reptile skulls are composed of a number of fused bones. Two of these, the squamosal and the quadrate, are the most important elements in the upper jaw. The *lower* jaw is made up of three bones, the dentary, angular, and articular. The jaw joint is the point of interaction between the articular, a small bone on the back of the lower jaw, and the quadrate, a small bone on the back of the upper jaw.

ii. Mammals.

Mammal skulls also begin as multiple bones that fuse together during embryonic development. The lower jaw has a single bone, the *dentary*. One of the skull bones, the *squamosal*, has a groove into which the dentary fits. This is where jaw articulation occurs in adults. In humans, this is commonly known as the temporo-mandibular joint, or TMJ.

In contrast to placentals, monotremes and marsupials do not fully develop before birth or hatching. Their embryos go through several months of post-birth development before their jaw articulation looks like that of adults. At first, they seem to have a TMME. However, when fully developed they end up with a DMME.

Visual # 8-39 In order for mammal jaws to have evolved, the angular and the articular would have had to move from the lower to the upper jaw. Somewhere along the way, the transitional forms would have at least temporarily had double jaw articulation, with both squamosal/dentary and quadrate/articular interactions. There would have been two bones in the jaw and two in the middle ear.

b. Middle ears and hearing.

If hard parts such as bones are preserved we can sometimes detect certain anatomical features in fossils. Such is the case with the bones of the middle ear, important not only for hearing but also as a support for the jaws to enable biting and chewing. Jaws and middle ear bones are very different in reptiles and mammals.

Visual # 8-40 Reptiles, of course, have a reptilian middle ear. By contrast, all adult mammals have a Definitive Mammalian Middle Ear, or DMME. They would have had to evolve from some sort of ancestral reptilian structure that had a Partial Mammalian Middle Ear (PMME) and then go through a Transitional Middle Ear stage, or TMME.

i. Reptile Hearing.

In the middle ear of reptiles only one bone, the columella, connects the eardrum to inner ear. It corresponds to the stapes of mammals. The other two bones supposed to correspond to those of mammals, the articular to the malleus and the quadrate to the incus, are on the opposite side of the eardrum and have nothing to do with hearing. In mammals, they are supposed to have not only moved to the opposite side of the eardrum but also from the lower to the upper jaw.

The Organ of Corti has never been found in any reptile, either fossil or living.

ii. Mammal Hearing.

Visual # 8-41 The bones of the middle ear having to do with hearing are closely associated with the upper jaw. In adult mammals, the malleus (hammer), incus (anvil), and stapes (stirrup) are all on the inner side of the eardrum. However, this is not the case in the embryonic stage of monotremes and marsupials.

As sound waves hit the eardrum, these three bones transmit the vibration and amplify the mechanical motion due to the sound. The last of the bones, the stapes, presses against the cochlea in the inner ear so as to transmit sound waves to the fluid inside it. The cochlea contains the Organ of Corti, the primary hearing organ. This converts the sound pressure waves to electrical signals to be sent to the brain.

In order for mammal middle hearing to have evolved, the angular and articular would not only have needed to move to the upper jaw, but also to the opposite side of the eardrum from the columella so as to develop into the malleus and the incus. There is more to the mammalian hearing system than just three bones, though.

- As in reptiles, the outer ear gathers sound waves and directs them to the eardrum.
- Unlike the reptilian system, the middle ear uses three bones instead of one. The malleus (hammer) is pressed against the inner side of the eardrum, through which the vibrations of sound pass. The malleus transmits the motion to the incus (anvil). This bone in turn causes the stapes (stirrup) to vibrate against the oval window on the cochlea in the inner ear.
- Similarly to reptiles, the cochlea is filled with fluid. However, in complete contrast to reptiles, the cochlea contains the aforementioned structure called

the Organ of Corti. This structure has a lower (basiliar) membrane, which vibrates in response to the vibration of the fluid. The organ flexes, causing hairlike cells to press against the upper (tectorial) membrane. The flexing of the individual hairs produces electrical signals, which are sent on to the brain to be interpreted as sounds.

The Organ of Corti is one of the most mechanically complex structures in mammals. It would have had to evolve in one or more transitional steps as a result of multiple mutations in DNA. However, there are no known fossil or living types showing its origin and development. It is either fully developed, as in all known mammals, or absent, as in all known reptiles.

2. WHY WOULD MAMMALIAN JAWS AND MIDDLE EARS HAVE EVOLVED??

Visual # 8-42

In order for some ancient animals to have undergone a transition from reptiles to mammals, their jaws would have needed to go through a stage with both squamosal/dentary and quadrate/articular hinges. In addition, the two aforementioned bones of the lower jaw would have had to move to the upper jaw and across the eardrum to become the bones of the middle ear (Anthwal et al, 2020, 1).

Like all physical structures in living things, these features would have had to be the result of mutations in the DNA inherited from their ancestors. Since marsupials, monotremes, and placentals are supposed to have evolved independently from a common ancestor that lived around 170 MA (Luo, 2011, 363), the mutations needed to change from reptilian to mammalian jaws would have had to occur at least three times (Anthwal et al, 2020, 2; Kermack et al., 1973, 164) to produce the three groups. Meanwhile, the bone structure of the middle ear – considered more complex than the jaw joint – also had to evolve at least two separate times (Kermack et al., 1973, 164-165; Luo, 2011, 364-369).

It is unclear how the transitional forms would have been able to hear during the many generations while the bones were moving across the ear drum. Somewhere during the transition, the new Organ of Corti would have had to appear as a result of all these beneficial mutations.

F. PROPOSED TRANSITIONAL FORMS - MORGANUCODONTS.

Visual # 8-43

A small number of fossils known as the Morganucodontidae or Morganucodonts are claimed to have had the kind of double jaw articulation expected in transitional forms (Anthwal et al, 2020, 1). They are estimated to have been shrew-sized, 10.7 - 25 g or less than one ounce (Newham et al., 2020, 3-5). This group is usually considered a separate suborder from both reptiles and mammals (Kermack et al., 1973, 109). The name comes from the genus believed to best express the overall characteristics. *Morganucodon* ("Glamorga tooth") is named for the region of Glamorga in Wales.

Morganucodonts are known from scant fossil evidence. We do not have a complete fossil, a complete skull, or even a complete jaw of even a single individual included in this group. The species and genera are all described in paleontology journals based mainly on teeth and parts of jaws.

1. REPRESENTATIVE TYPES.

The following are often grouped within the Morganucodonts. Except for those specially noted below, most of the other genera are known only from isolated teeth (Debuysschere et al, 2014, 2). Most dates are from Mindat.org.

a. Gondwanadon (237-228 MA, only in India),

b. Brasilodon (225 MA),

c. Eozostrodon (210 MA), often considered a mistaken synonym for *Morganucodon* (Kermack et al., 1973, 96, 107).

d. Kuehneotherium (206-199 MA), only a single species and known only from teeth, dental fragments, and mandible fragments. No *Kuehnotherium* skulls are known (Gill et al, 2014, 306).

e. Brachyzostrodon (209 MA),

f. Erythrotherium (Lower Jurassic), known from one nearly complete skeleton from Lesotho,

g. Helvetiodon (209 MA),

Visual # 8-43

h. Morganucodon (205 MA), from which the group drew its name.

i. Megazostrodon (200 MA), known from one nearly complete skeleton from Lesotho and from one nearly complete skull from S. Africa,

j. Hadrocodium (195 MA) (Luo et al., 2001) is dated to the Early Jurassic, ten million years after the supposedly earliest mammal *Morganucodon*.

k. Paikasigudodon (183 MA),

l. Wareolestes (168 MA),

m. Yanocononodon (129 MA).

n. Liaoconodon (120 MA) is known from a single fossil designated IVPP V16051. It was claimed to have a middle ear of the type that would be needed in a transition from reptiles to mammals (Meng et al., 2011).

One of the characteristics of both reptile and mammal skulls is the presence of a structure known as Meckel's cartilage during embryonic development. In some animals it is later absorbed, while in others it turns to bone. Meng et al. postulated that this cartilage must have persisted long enough to support the middle ear bones of *Liaoconodon*.

Visual # 8-44

The worst problem with this scenario is that *Liaoconodon* is dated to the Early Cretaceous, 120 MA. By comparison, *Morganucodon* is dated to the Late Triassic, about 205 MA. *Liaoconodon* occurs over 80 million years too late to be a transition from reptile to mammal. It seems to have simply been some previously unknown mammal at an unknown stage of development.

2. FOSSIL EVIDENCE FOR MORGANUCODON.

Visual # 8-45

A number of museums (e.g., the Smithsonian National Museum of Natural History in Washington, DC in 2016) have presented prominent exhibits proclaiming *Morganucodon* ("Morgie") as the ancestor of all primates and therefore humans. Since there are such bold claims about it, it is worth studying in detail.

There are no known complete skeletons, skulls, or jaws of *Morganucodon*. All of the other types included within the morganucodonts are likewise based on fragments. All the displays in museums are nothing more than artists' conceptions.

Visual # 8-46

- The single fossil reproduction in the Smithsonian display is a fragmented lower jaw bone from the Pontalun quarry at Glamorga (Kermack et al., 1973, 128). No other parts are present.
- *Morganucodon* is known from hundreds of teeth (Debuysschere et al, 2014) and bone fragments, but no complete body fossils have been reported.
- Likewise, skulls and lower jaws are rare. As of 1973, there were only 7 known specimens of lower jaw fragments from Glamorga, along with a few fragments of prearticular bones. All were tiny, with the whole jaw size similar to that of the European mole (Kermack et al., 1973, 118).

- All the angular bones of *M*. at Glamorga were broken (Kermack et al., 1973, 148). As of that date, not a single complete dentary of *Morganucodon* was known (Kermack et al., 1973, 124).
- Only one articular complex was known, but it was embedded in the sedimentary matrix and was too fragile to remove so that only one side is visible (Kermack et al., 1973, 118).
- Because of the fragmentation of skulls, skull lengths are estimates only (Newham, 2020, 10). Complete *Morganucodon* skulls are rare, only found in the Red Beds of the Lower Lufeng Formation in China in the form of the species *M. oehleri*.
- Prior to 1995, only a single specimen of *M. oehleri* was known, from Lufeng (Kermack et al., 1973, 88, 90-93). Then in 1995, a single new skull with complete upper dentition (no parts from the lower jaw, only the skull) was considered sufficient to justify publication of a new article. Even that skull was crushed. It had a quadrate/articular joint, but the mandible (lower jaw) was separate from the skull and fractured into several segments (Luo et al., 1995, 671-6)

  Several specimens claimed to be similar to *Morganucodon* have been identified at the Kayenta Formation of Arizona. The only fossils reported from that location as of this writing (2023) are a crushed skull, some postcranial bones, and four isolated teeth (Jenkins et al., 1983).

3. DIFFERING INTERPRETATIONS FOR THE FOSSILS.

The vast majority of *Morganucodon* and similar fossils are isolated teeth. Nevertheless, a few jaw and skull fragments have been found and used as the basis of reconstructions. They are claimed to be transitional between reptiles and mammals because some seem to have had jaws with two points of interaction, the quadrate/ articular and squamosal/ dentary.

In order for such structures to evolve, some ancestors with a fully functional reptilian jaw and middle ear would have had to experience many mutations in their DNA to produce transitional stages with the double jaw joint and relocated middle ear bones. As noted previously, the reptilian articular would have had to move from the lower to the upper jaw and across the eardrum in order to evolve into the malleus. Likewise, the reptilian quadrate would have had to move from the lower to the upper jaw and across the eardrum in order to evolve into the incus.

Since the relocation of the ear bones across the eardrum would have had significant effects on the sense of hearing, the transitional forms would have to be able to survive with limited or no ability to hear. The DNA of their descendants would have had to continue acquiring mutations so as to eventually produce the mammalian jaw and middle ear arrangement. Thus, the overall sequence would have been from reptiles with moderate low-frequency hearing, to transitions with little or no ability to hear, to mammals with excellent hearing in all frequency ranges.

Some of the fossil reconstructions do seem to show a transitional stage with bones moving across the eardrum. However, the Partial Mammalian Middle Ear (PMME) of Mesozoic specimens supposed to be transitional is similar to the embryonic and neonatal structures of some extant mammals (Luo, 2011, 359).

Most authors assume the alleged transitional fossils represent adults. As we shall see below, the young of some living mammals, the marsupials and monotremes, go through such a stage before they are fully mature. The question is: *were these fossils adults, or juveniles?*

- They are all found in water-deposited sediment and are almost always disarticulated into individual broken bones, they way they would have been if carried along by flowing water (Kermack et al., 1973, 96-97). A flood could have buried immature specimens just as easily as adults.
- The Glamoraga specimens (*M. watsoni*) came from fissure fillings in 3 limestone (sedimentary) quarries (Kermack et al., 1973, 90). All the recognizable bones were found in one small area, the Ewenny quarry (Kermack et al., 1973, 102), all within one square mile (Kermack et al., 1973, 107).
- There are only a small number of genera present, all roughly the same size, and all disarticulated. (The two *M. oehleri* fossils from Lufeng are only slightly larger than *M. watsoni* specimens.) Kermack et al. (1973, 97) speculate that the animals were eaten by predators and that bone fragments were all that were left, similar to the way fragmented bones of small rodents are found in "owl pellets" studied by elementary school students.

4. SIMILARITIES OF MORGANUCODONT JAWS AND MIDDLE EARS TO LIVING EMBRYONIC MONOTREMES AND MARSUPIALS.

As far as we can tell, all the Morganucodonts are extinct. However, based on the large number of teeth available, Kermack et al. (1973, 105-107) point out that they do not seem to have had the manner of tooth replacement found in living placentals and marsupials (*therians*). Kermack believes the Morganucodonts were *atherians*. That is, if they were truly mammals, they would not necessarily be monotremes, but would be more similar to them than to any other living forms.

It may come as a surprise that marsupials and monotremes both go through a stage with seemingly intermediate structures during their embryonic development (Luo et al., 2001). However, those structures later change into the typical adult mammal middle ear.

a. Monotremes.

Visual # 8-47

If the fragmented fossil specimens developed in a way similar to living monotremes, this could explain why their jaws seemed to have a double articulation.

- The newly hatched embryos of living monotremes do not have fully formed jaws and middle ears. They develop a double jaw articulation, which disappears as they mature into adults (Anthwal et al, 2020, 7).
- Monotremes hatch as quickly as 10 days after fertilization, while the embryo is still going through a great deal of development. In early nursing, the embryo mainly depends on the joint that would be analogous to the quadrate/articular. After a period of further development, the dentary/ squamosal becomes the operational jaw hinge (Luo, 2011, 371). The Q/A disappears.
- Monotreme middle ears also develop differently from placental mammals. From hatching until weaning, the incus is fused to other structures, It gradually separates between about 10 to 80 days (Anthwal et al, 2020, 5-6), as the animal becomes less and less dependent on lapping up the mother's milk. After about 80 days, the incus is no longer fused.
- Embryonic development in the platypus can take up to 120 days. Since the middle ear bones take a significant amount of time to move into position, the sense of hearing seems to be very late in developing (Anthwal et al, 2020, 7).

Visual # 8-48

b. Marsupials.

Marsupials are a bit more developed than monotremes at the time of birth, but their jaw and ear structures are far from finalized. The newborns crawl into the mother's pouch, where they latch onto a teat and nurse for weeks or months. The dentary/squamosal joint is not yet fully developed (Luo, 2011, 361), but is well suited for firmly attaching to the teat. The anatomy of the embryonic opossum, for example, allows the middle ear to be braced against the cranium during sucking (Anthwal et al, 2020, 12).

c. Common features.

Both opossums (marsupials) and platypuses (monotremes) use the middle ear bones to support the articulation between the lower jaw and the head before the adult jaw joint forms (Anthwal et al, 2020, 2). There is a time during which the primary jaw joint (which later develops into the malleus and incus) does not provide a site of articulation (Anthwal et al, 2020, 4). Meanwhile, the developing ear ossicles furnish transient jaw support in the embryonic development of both marsupials & monotremes.

Though *Morganucodon* skull fossils are rare, four petrosal bones (part of the temporal area on the skull) were analyzed and found to have a straighter cochlear cavity than most mammals (Graybeal et al., 1989, 114). However, the cochlear cavity of some embryonic marsupials and monotremes changes shape from birth/hatching to maturity (Ashwell & Shulruf, 2014). Unless we know whether these four were developing or adult specimens, we cannot draw firm conclusions based on the cochlea.

5. *POSSIBLE ALTERNATE EXPLANATION FOR MORGANUCODONT FOSSILS.*

Since the Morganucodonts seem to be extinct, we cannot be sure how rapid their embryonic development was, how long it took to reach completion, nor how old the individuals were when they were buried in water deposited sediment. However, there are several possible explanations for what seem to be transitions.

i. Initial disorganization: They really were transitions from reptile to mammals.

ii. Initial complexity: They were some sort of unknown mammal with a great many similarities to monotremes.

As yet, neither explanation can be tested.

III. CHAPTER SUMMARY.

Visual # 8-49

Visual # 8-50

This chapter was not intended to prove that creation (Initial Complexity) is correct, only that it is a plausible alternative to evolution.

Scientists routinely depend on a principle known as "Occam's Razor," which could be paraphrased as "The simplest explanation that fits all the facts is probably the best."

- One possible explanation is that some ancient animals such as the morganucodonts evolved into at least three lines of descendants: the monotremes, marsupials, and placentals. There would have had to be thousands or millions of parallel beneficial mutations in all three lines to later diversify into at least thirty-two known orders with all the features of mammals such as warm-bloodedness, diaphragm breathing, jaws, middle ears, Organ of Corti, etc. in each group. At each step, a male and female would have to acquire complementary mutations in their reproductive systems.
- An alternate possible explanation is that the small number of fossils that have been found represent incompletely developed juveniles belonging to an extinct type of animals with a method of embryonic development somewhat akin to that of the living monotremes and marsupials.

All we can do is determine which seems more reasonable.

The fossil evidence used to support evolution from reptiles to mammals is extremely scarce. With such a small number of jaw and cranial fossils, it would be deceptive of curriculum authors and science teachers to say which, if any, of the above is correct. We should present the evidence to students so they can choose for themselves which to believe. We should also give them the option not to choose if they think the evidence is insufficient.